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### **China-Japan Green Aid Project (GAP) “Tiefa Coal Mine Area Methane Recovery and Utilization Demonstration Project” Completed in Success**

The China-Japan Green Aid Project (GAP) “Tiefa Coal Mine Area Mine Methane Recovery and Utilization Demonstration Project” completion ceremony was held in Tiefa Coal Group, Liaoning Province on October 19, 2002.

Started in 1992, the Green Aid Project is an inter-governmental cooperative project between the Chinese government and the Japanese government. Content of this project is that the Japanese side is to provide equipment and the Chinese side is to produce supporting funds to carry out energy saving and environmental protection demonstration projects in China. Till now, a total of 36 green Aid projects are under way and the “Tiefa Coal Mine Area Mine Methane Recovery and Utilization Demonstration Project” is one of these projects. Implemented by Tiefa Coal Group Co Ltd, this project lasted for five year from 1999 ~ 2002. This project aims at improving the mine methane drainage and extraction systems at coal mines to ensure improved work safety in coal mines, increased productivity, mitigated GHG emission and effective use of cleaner energy so as to contribute to the mitigation of global warming.

Involving total investments from both Chinese and Japanese sides of more than 92.0 million Chinese yuan, this project achieved a complete coal mine methane drainage and extraction system and part of a surface methane distribution and transmission system.

Work covered by this project includes underground methane drainage and extraction project such as bore-hole drilling, methane drainage and extraction, centralized monitoring and sealing system. Work done on the surface includes dry type spherical medium-pressure gas tank, heating value regulating installation, methane compressor and part of pipeline. This project also includes the following technical innovations: a successful application of methane extraction technique employing oblique crossing long bore-holes and the application of underground gob area sealing technique utilizing fly-ash discharged by power plants. A fully mechanized longwall face in Daxing coal mine was selected by this project for the related trial operation and the result is so successful in that an annual total methane production of 4.098 million  $\text{m}^3$  was realized, thus creating economic profit of about 3.0 million Chinese yuan. The designed capacity of methane transmission and distribution system of this project is sufficient to supply methane fuel to the total of 165,000 residents in that area including Tieling city.

### **Investment Opportunities in Coal Mine Methane Projects in Pingdingshan Mining Area**

Pingdingshan Coal Group Co., Ltd.(PCG) is one of the 520 largest industrial enterprises of China and at the same time it is the third largest coal producing enterprise in China. It produces an annual production of 19.0Mt of coal. According to the development plan of the company, annual coal production of PCG will be maintained at the level of around 23.50Mt during the next ten years.

Pingdingshan mining area is endowed with very rich coal and coalbed methane resources. The proven coal reserves here is around 7.6 billion tons while the recoverable coalbed methane resources are registered at 65.2 billion  $\text{m}^3$ . All of the 14 active coal mines of PCG belong to the category of gaseous mine with gas content in their major recoverable coal seams at 6 ~ 15 $\text{m}^3/\text{t}$ . In 2000, the annual total methane emissions in this mining area were recorded at over 200.0 million  $\text{m}^3$ . Along with the increase of mining depth and increasing coal production capacity, methane emission also has been increasing over the past years. So far, 9 out of the total of 14 coal mines of PCG have been equipped with underground gas drainage facilities. Three of them are using surface pump stations. The year 2000 witnessed the total extraction of 25.88 million  $\text{m}^3$ . With more pump stations completed and commissioned, coal mine methane drainage would experience further marked growth.

Currently, less than 0.20 million  $\text{m}^3$  of methane is utilized annually, accounting for less than 1% of the total drainage. Just because of this, PCG hopes to set up a small-sized CMM power plant for a full utilization of the drained coalbed methane. This project is also believed to be profitable. Besides, coal seams in the middle part of Pingdingshan coal field are in medium depth with very rich CBM content. The average gas resources intensity is 155.0 million  $\text{m}^3/\text{km}^2$ . What is more, its permeability is as high as 1 ~ 5md. The surrounding large and medium sized cities always have very large and urgent demands for cleaner energy. It is also the intention of PCG to develop coalbed methane resources through surface well to supply such

cleaner fuel gas to the nearby cities.

The following is a summary of the two potential CMM/CBM projects for which PCG is seeking investments:

- 1) *“East-three-mines” CMM power generation project.* This project is to utilize the CMM recovered from the “east-three-mines” of Pingdingshan mining area, namely, No.8, No.10 and No.12 mines. A 6MW CMM power plant is proposed for set-up in No.12 mine for electric power generation and supply to the mining area. The daily CMM consumption of the power plant will be 43,200 m<sup>3</sup>. Total investment of this project is estimated at 36.2 million yuan (US\$ 4.36 million). Of this total, PCG is to provide 35% and the remaining 65% is to be provided by outside financing sources. Based on the total investments of 36.2 million yuan (US\$ 4.36 million), the estimated NPV of this project is 14.95 million yuan (US\$ 1.8 million), the estimated IRR would be 23% and the pay-back time would be 7 years. It is anticipated by PCG that this project be started in 2002 early and be fully implemented by the end of 2002.
- 2) *CMM surface development project.* Surface vertical well development technology is to be employed for this project. It is planned that a total of 100 vertical wells are to be drilled in the middle part of Pingdingshan coal field for CMM extraction and the fuel gas extracted will be supplied to the surrounding cities. The CMM production capacity of this project would be 90.0 million m<sup>3</sup>/a with a total service life of 30 years.

Total cost of this project is estimated at 200.0 million yuan.

PCG recognizes that investments in these projects may entail some certain risks, such as the potential fluctuations in CMM supply and changes in electricity sales prices. Risk also arises with the problem if CMM sale agreement is signed prior to the implementation of the projects. PCG is prepared to help potential investors address these concerns. PCG may also be able to answer questions about other important issues concerning the repatriation of profits.

PCG would like to consider various types of partnership and financing sources in order to realize the proposed projects. Representatives of bank, foreign companies, foreign governments and international agencies are encouraged to review the attached marketing package.

### **Jincheng Coal Group CBM/CMM development and utilization plan for the tenth “Five-Year-Plan” period**

As one of the extra-large coal mine companies of China, Jincheng Anthracite Coal Group was set up in 1958. This 10.0Mt capacity coal mining tycoon has a total mining area of 960km<sup>2</sup>. Jincheng Coal Group is endowed with simple geological structure, good coal seam characters with methane content of 10 ~ 20m<sup>3</sup>/t. Jincheng Coal is also endowed with very rich CBM/CMM reserves with an extractable CBM/CMM reserves totaling 728.0 million m<sup>3</sup>.

CBM/CMM development and utilization has

been listed in the resources development and utilization plan of this mighty coal company for implementation during the tenth “Five-Year-Plan” period (2001 ~ 2005). Considering the fact that surface drainage and underground extraction always produce CBM/CMM at varied methane purity, the CBM/CMM development and utilization plan deals with surface drainage and underground extraction differently and gives appropriate plans to the two different development schemes.

#### 1. Implementation of underground CBM/CMM extraction project in Sihe coal mine

Sihe coal mine is endowed with very rich CBM/CMM reserves. Within its area of 91.2km<sup>2</sup>, CBM/CMM reserves is in the range of 25.002 billion m<sup>3</sup> of which 8.99 billion m<sup>3</sup> is recoverable CBM/CMM reserves. So far, CBM/CMM extraction design with the capacity of 400m<sup>3</sup>/min and 200m<sup>3</sup>/min at the initial stage has been worked out and the extraction system has been completed and put into gas extraction operation. Based on the conclusions of the “Feasibility report on underground CBM/CMM extraction in Sihe coal mines, Jincheng Anthracite Coal Group”, CBM/CMM must be extracted five years before coal mining actually happens in Sihe coal mine. Otherwise, work safety in the coal mine will be problematic. This project has been implemented in Sihe coal mine. It is expected that CBM/CMM extraction from the underground will amount to an annual total of 200.0 million Nm<sup>3</sup>/a after the year 2004. This project will need a total investment of 261.486 million yuan and the project is to be constructed during 2003 ~ 2008.

#### 2. Implementation of Panzhuang CBM surface extraction project

CBM extraction has been tested in demonstration wells and group wells in Panzhuang mine field. The results obtained indicate that CBM reserves here is rich and good geological conditions for CBM development are in place. In order to prove the stableness of CBM production so that industrial scale CBM extraction is realized, it is planned to carry out enlarged CBM unit industrial scale test in Panzhuang mine field. So far, the pre-feasibility research report has been completed for the Panzhuang mine field CBM surface extraction project.

Size of the project: 100 CBM extraction wells at per well gas production rate of 2500 ~ 3000 Nm<sup>3</sup>/d. Once the project is completed, an annual total gas production of 1.05 X 10<sup>8</sup>m<sup>3</sup> will be realized. Total investment needed is 325.20 million yuan and the construction time is 2003 ~ 2005. When the project finally reaches its designed capacity, it will produce an annual total gas sales revenue of 260.82 million yuan with an annual total profit of 61.08 million yuan.

#### 3. The project of 120MW power plant at Sihe coal mine

Jincheng Anthracite Coal Group plans to utilize the low purity CBM extracted from Sihe underground mine to generate electric power, thus the idea of constructing the Sihe coal mine 120MW CBM fired power plant came into being. According to the evaluation report completed by China International Project Consulting Corp, this power plant project is in the category of resources comprehensive utilization, which is

quite in conformity with the basic state policy of promoting sustainable development and naturally the project will produce significant economic, social and environmental benefits. The CBM/CMM reserves to serve this project is readily reliable, the technical plan is rational and feasible and its economic and accounting indices are optimal. The implementation of this project will produce a positive and demonstrative influence on the CBM/CMM development and utilization in coal mine areas in this country. This project was ratified and approved by the State Development Planning Commission in December 2001. So far, the feasibility study report of this project has been completed by China Mechanical & Electrical Research Institute and the supporting documents such as environmental evaluation report, water resources study report and the research report on the connection of this project with the local power grid have all passed their respective approval procedures.

#### 4. Laying fuel gas transmission pipeline to provincial energy company

Due to the fact that natural gas is in short supply in Shanxi Province, the size of CBM/CMM market in this province is expected to be a very large one. Shanxi Province Energy Corporation plans to construct a CBM transmission pipeline that runs from Bajiakou – Jincheng city – Gaoping city – Changzhi city, all in Shanxi Province – Shexian county in Hebei Province. The project under this headline will be the section from Yangcheng – Duanshi gas field – Changzhi city – Lucheng – Shexian in Hebei Province. CBM gas will be extracted from Duanshi gas field in Qinshui coal basin in Shanxi Province. Total

length of this CBM pipeline project is about 200km with designed CBM/CMM pressure at 6.4Mpa. Its annual gas transmission is  $10 \times 10^8 \text{ m}^3$ . This pipeline is designed to use 426mm pipes which is either used as natural gas supply line to local counties and cities on the way of the State energy project “western natural gas transmission to the east” and at the same time it is also used as CBM gas supply line to feed the “western natural gas transmission to the east” project as the production of CBM gas grows with the years. Jincheng Anthracite Coal Group has signed relevant letter of intention on CBM gas supply with relevant authorities, which means the market of the CBM has been preliminarily in place. This is a very important aspect of the commercialization of the CBM/CMM development and utilization project.

### **Difficulties and challenges in front of CBM/CMM industry development in China**

The idea of CBM/CMM development and utilization has now been accepted by more and more leaders at all levels from governments to relevant industrial enterprises. Some certain obstacles, however, still exist on the way of CBM/CMM development. Only on the basis of achieving a clear analysis and identifying appropriate solution to these problems can we push the CBM/CMM industry to a new development phase.

#### 1. CBM/CMM theory calls for new breakthroughs

CBM/CMM related geological theory calls for breakthroughs. This is because of the

complexity of the coal field geology of China, where the CBM/CMM geological theory and CBM/CMM development technology introduced from foreign countries are used but not appropriately. CBM/CMM geological theories that are well adapted to the actual geological conditions in China (for example low pressure, low permeability, serious damages to geological structure and existence of high rank coal with higher gas production rate are widely found in the majority of coal reserves) are to be developed to provide guidance to the CBM/CMM development and production. A set of systematic and mature CBM/CMM geological theory and evaluation method will have to be developed to suit to the actual geological conditions in China. This is of crucial importance to the successful development of CBM/CMM industry in this country.

## 2. China currently lacks effective method and means to identify highly concentrated CBM/CMM reservoirs at high permeability rate

The lack of effective method and means to pinpoint highly concentrated CBM/CMM reservoirs at high permeability add to the risks involved in CBM/CMM exploration. Systematic research and development is to be strengthened in this field. In some foreign countries, many methods are used to look for highly concentrated CBM/CMM reservoirs before actual drilling is carried out. This includes remote sensing image geological analysis technology, organic earth chemical exploration technology and ground stress testing technology, etc. In China, the first method used in identifying the CBM/CMM development block is to refer to

the coal field geological data available. Another method used is borehole drilling that involves very high costs. It is necessary to change the current status of CBM/CMM exploration in China so as to lower related costs and shorten the investment payback time. Although successful CBM/CMM exploration and development operation has been achieved in some certain areas of this country, much remain to be done for further practice, experience summary, improvement and further perfection of the maturity of complete set of systematic CBM/CMM exploration and development technology that is well adapted to the Chinese conditions.

## 3. Upper stream and down stream industrial development is to be improved

Now that the CBM/CMM industry is just in the initial development stage, the government departments are sparing no efforts in pushing forward infrastructure construction in CBM/CMM development key areas. This includes construction projects in telecommunications, environmental protection, communications and services industry, construction of natural gas pipelines, natural gas storage projects and natural gas utilization projects, etc.

## 4. The state government should prepare more preferential policies to encourage the development of CBM/CMM industry

The current preferential policies encouraging the development of CBM/CMM industry are almost identical to that specially prepared for the conventional natural gas industry. Although CBM/CMM can be mixed with conventional natural gas for mixed transportation and

consumption, the production process of CBM/CMM is so characterized that it differs greatly from that of the conventional natural gas in terms of the means for exploration, development, production and production capacity. Under general conditions, the single well daily CBM/CMM production rate is far below that of natural gas, thus it is very natural that the investment pay-back time is much longer than that of the natural gas project. Hence experts suggest that the Chinese government should prepare special preferential and favorable policies for the development of CBM/CMM, which should include reducing VAT rate from 5% down to 2%, income tax exemption period be extended to 10 years. Only in this way could the CBM/CMM industry be encouraged to take shape and enlivened.

5. CBM/CMM development calls for inviting the participation of foreign capitals

The Chinese coal mine companies and enterprises lack the capitals to be invested in the CBM/CMM development and utilization projects now. Right in the course of reform, the Chinese coal mine companies and enterprises are under very heavy burdens that are left over from the long history of development. Also because of the

“triangle debts” on account of the arrears in coal sales payment mainly caused by the down stream industrial enterprises, coal mine companies and enterprises have just helped themselves out of the most difficult time. Without the influence of proven and successful cases, it is very difficult for the Chinese coal mine companies and enterprises to do any thing in venture capital investment.

In the initial stage of CBM/CMM industry development in China, it is not only necessary for the state government to provide inclined rules and regulations to encourage the development of this emerging industry in terms of capital input, favourable taxation, loans, financing and R&D, it is also necessary for the central government to prepare special rules and policies to encourage the development of CBM/CMM industry. Practical cases show that appropriate policies and regulations will always help realize the healthier, rapid development of an industry in an orderly way. As an emerging industry, CBM/CMM industry needs appropriate regulations for its survival and appropriate policies for its further development.

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